PLATINUM NANOPARTICLES ON NITROGEN-DOPED GRAPHENE FOR OXYGEN REDUCTION REACTION

Ágnes Tímea Varga[1], Tamás Varga[1], Henrik Haspel[1,†], Ákos Kukovecz[1], Zoltán Kónya[1,2]

1 Department of Applied and Environmental Chemistry, University of Szeged, H-6720 Szeged, Rerrich Bela tér 1, Hungary
2 MTA-SZTE Reaction Kinetics and Surface Chemistry Research Group, H-6720 Szeged, Rerrich Béla tér 1, Hungary
† Present address: Division of Physical Sciences and Engineering, KAUST Catalysis Center (KCC), King Abdullah University of Science and Technology (KAUST), 4700 KAUST, Thuwal, 23955-6900, Saudi Arabia.

Abstract:

Excess use of non-renewable energy resources is a serious environmental problem nowadays. Fuel cells can be a promising alternative as they provide rather clean energy and they can be used for various purposes in many sizes. Our work focuses on the oxygen reduction reaction (ORR) in polymer electrolyte membrane (PEM) fuel cells. Generally, platinum nanoparticles are used on carbon black support which is an expensive and easily degradable catalyst. Nitrogen-doped graphene support can be an alternative solution with various advantages, which improve the ORR efficiency of the dispersed platinum. Our aim was to achive a one step method to synthesize Pt/Nitrogen-doped graphene composite with reduced platinum content. A mixture of platinum (II)-acetylacetonate and graphene oxide was thermally treated at three different temperatures. The resulting material was examined by several characterization techniques: thermogravimerty (TGA) was used to determine the platinum content of the samples, transmission electron microscopy (TEM) was applied to examine the graphene sheets and platinum particles, and X-ray photoelectron spectra (XPS) were taken to determine the physical states of the graphitic materials and the oxidation state of Pt. Linear sweep voltammetry (LSV) and cyclic voltammetry (CV) were performed in a three-electrode cell in oxygen saturated 0.1 M $HClO_4$ solution by a rotating disk electrode (RDE) at different rotation rates to see the electrochemical behaviour of the samples, compared to a conventional Pt/CB catalyst. The results revealed the successful synthesis of the desired catalyst with promising electrochemical performances.